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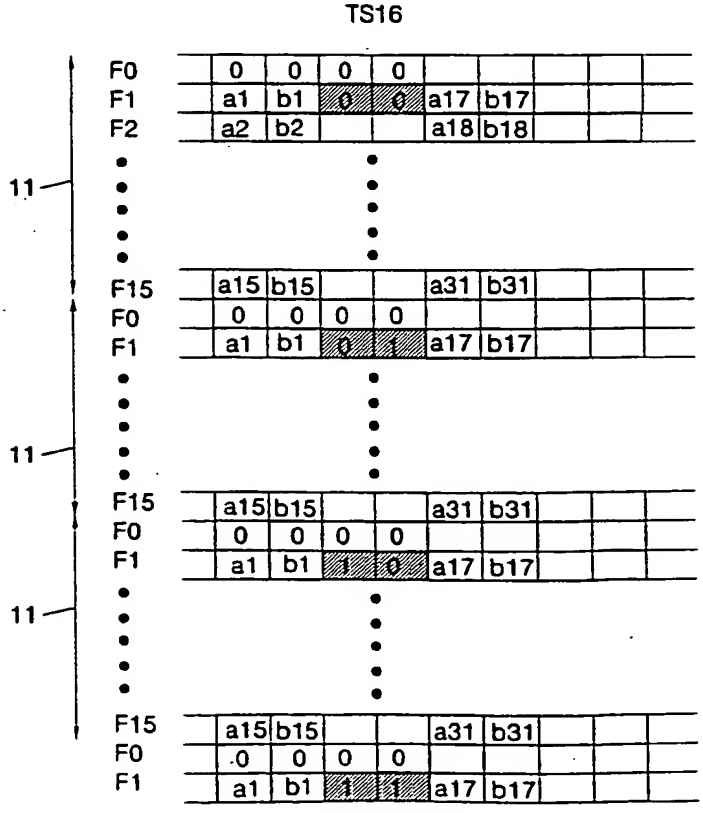
(54) Title: METHOD FOR TRANSFERRING ANCILLARY INFORMATION IN A BASIC TIME-DIVISION MULTIPLEX SYSTEM

(57) Abstract

The invention relates to a method for transferring ancillary information, such as channel-associated signalling and alarms in a basic time-divison multiplex system, where ancillary information is transferred in a predetermined timeslot (TS16) of each frame, and where information associated with more than one channel is transferred in at least one timeslot (TS1...TS15, TS17...TS31) of the basic system. To provide a method allowing the ancillary information, particularly signalling and alarms,-to be transferred with as high compatibility as possible in a conventional basic multiplex system up to a capacity of 120 speech channels, a superframe (12) having the length of several multiframes (11) is assembled, and at least part of the ancillary information is transferred in said predetermined timeslot (TA16) so that the number of the multiframe is transmitted in addition to said ancillary information, the number indicating with which channel the ancillary information is associated.



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Method for transferring ancillary information in a basic time-division multiplex system

The invention relates to a method for transferring ancillary information, such as channel-associated signalling, in a basic time-division multiplex system, where ancillary information is transferred in a predetermined timeslot of each frame, and where information associated with more than one channel is transferred in at least one timeslot of the basic system. The method according to the invention is especially intended for use in connection with the European 2048 kbit/s 30-channel basic multiplex system, but it is not restricted to this standard only.

In the 2048 kbit/s basic multiplex system defined in the CCITT specification G.704, channel-associated signalling CAS is transferred in a timeslot TS16 by grouping successive frames into larger multiframes containing 16 frames. The timeslots TS16 of successive frames in the multiframe are assigned one at a time to a signalling channel corresponding to two separate speech channels. Accordingly, there are four bits available for each signalling channel in the timeslot. The signalling channels occupy the timeslots TS16 of fifteen frames contained in the multiframe. The timeslot TS16 of the remaining frame 0 contains e.g. a multiframe synchronizing signal, as will be described below.

The basic system described above allows the transfer of 30 speech channels having a capacity of 64 kbit/s. Today, however, it is possible to use advanced speech coding methods by which the capacity of the 2048 kbit/s system can be increased up to 60 or even 120 speech channels. In such a case it is necessary to

code the information of the speech channels by a transcoder.

The CCITT specification G.761 defines a 32 kbit/s ADPCM transcoder with accurately specified fixed timeslot mapping, signalling transfer and alarms handling. This transcoder cannot, however, be connected to the 2048 kbit/s basic system as the bits it employs for alarm transfer are reserved for national use in the specification G.704. A reliable transfer of alarms cannot therefore be guaranteed.

On the other hand, even though the CCITT specifications G.726 and G.727 define 16 kbit/s speech coding, a transcoder realizing it has not yet been specified. One reason for this is that the transfer capacity of the timeslots TS0 and TS16 is not adequate for conventional transfer of the channel-associated signalling of 120 channels.

The specification G.761 also defines alarms, such as forward and backward AIS (Alarm Indication Signal) alarms. However, the approach defined in the specification is not feasible when using a 16 kbit/s codec as the number of available bits is not sufficient for the transfer of alarms. This is because the network management also utilizes free bits available in the timeslot TS0, wherefore they are not available for the purpose specified in G.761.

The object of the present invention is to provide a method which avoids the above-mentioned shortcomings and allows the transfer of ancillary information, especially the transfer of signalling and alarms, in a conventional basic multiplex system up to a capacity of 120 speech channels. This is achieved by means of a method according to the invention which is characterized by assembling a superframe having a length of several multiframes, at least part of the

ancillary information being transferred in said predetermined timeslot so that the number of the multiframe is transmitted in addition to said ancillary information, the number indicating with which channel the ancillary information is associated.

The basic idea of the invention is to employ a lower signalling rate and to utilize the "extra" bits remaining in the timeslot transferring channel-associated ancillary information as "address bits" indicating which one of the transfer connections is being served.

According to a preferred embodiment of the invention, part of the ancillary information is transferred by changing the sequence of the multiframe numbers. The idea is thus to utilize the sequence of the multiframe numbers or a change in the sequence for transferring part of the ancillary information, such as alarms. It is to be noted that even though the term *superframe* will be used in the text below to illustrate the operation of the method to the reader, the operation of the method as such does not require a single superframe sync in all timeslots but the phase or sequence of the multiframe numbers may vary from one timeslot to another.

The solution according to the invention is also compatible with n x 2048 kbit/s networks as the "address bits" used in the invention eliminate delay deviations (the delay varies from one timeslot to another) occurring in cross-connect devices.

A further advantage of the invention is that the bits of the timeslot TS0 normally used for the network management are not utilized but they are still available for the network management purposes, as distinct from e.g. the above-mentioned specification G.761, where they are used for another purpose.

In the following the invention will be described in more detail with reference to the examples shown in the attached drawings, in which

Figure 1 illustrates the assembly of superframes from multiframes;

Figure 2 illustrates the transfer of ancillary information in the timeslot TS16 in successive multi- and superframes;

Figure 3 is a block diagram illustrating a transmitter section in a codec applying the method according to the invention; and

Figure 4 is a block diagram illustrating a receiver section in a codec applying the method according to the invention.

In the following, a 2048 kbit/s basic multiplex system transferring 120 speech channels by a 16 kbit/s speech coder will be used as an example. Each speech channel timeslot (the timeslots TS1...TS15 and the timeslots TS17...TS31) thus contains 4 coded speech channels.

Figure 1 shows a frame 10 in a basic multiplex system. The frame 10 comprises 32 timeslots TS0... TS31. As is well-known, the timeslot TS16 of the frame is used by two signalling channels so that there are four bits abcd available for each channel. In the system, sixteen successive frames F0...F15 form a multiframe 11 having a length of 2 ms. In a conventional system, service can thus be offered for 30 speech channels.

In a multiplexer providing conventional telephone service, the number of signalling bits actually transferred per channel can be reduced to two (the bits a and b hereinbelow). The other bits (the bits c and d hereinbelow) are typically connected to a fixed state, and so it is not normally necessary to send

them at all.

According to the invention, a superframe structure of four multiframes and having a length of 8 ms is assembled from the 16-frame multiframes 11. The above-mentioned bits c and d are used in such a manner that the transmitter unit always sends not only the actual signalling bits a and b but also the bits c and d indicating the number (1...4) of the multiframe in the superframe. This number indicates which one of the speech channels is being served currently, that is, the receiver employs the "address bits" c and d to update the signalling data of the appropriate speech channel. The signalling data of only one of the four speech channels is updated during the multiframe, and so the signalling of all speech channels will be updated once only after the superframe. In the arrangement according to the invention, the updating sync is thus reduced from the normal value of 2 ms (multiframe sync) to 8 ms. (When using a 32 kbit/s coder, the updating sync is correspondingly 4 ms.) In practice, the reduction of the sync even to one quarter of the original has no detrimental effects, as even a slower rate is adequate for normal telephone network signalling.

Figure 2 illustrates channel-associated signalling for the timeslot TS1. This is done by showing the content of the timeslots TS16 (there are 64 such timeslots in the superframe 12) in those of the successive frames where the signalling data of the timeslot TS1 is transferred. The third and fourth bit in the timeslot TS16 in the second frame F1 of each multiframe 11, that is, the above-described bits c and d indicate by the number (00, 01, 10 or 11) of the multiframe 11 to which speech channel of the timeslot TS1 the corresponding bits a1 and b1 are assigned.

Figure 2 further shows the first four bits abcd of the timeslot TS16 of the first frame F0 of each multiframe. These bits form the synchronizing signal, being all zeros. Correspondingly, the bits c and d (not shown) following the bits a17 and b17, for instance, indicate to which one of the four speech channels of the timeslot TS17 the bits are assigned. In the timeslot TS1 the bits cd form a sequence 00, 01, 10, 11, as described above. The superframe structure according to the invention may be incoherent, that is, the phase of the respective "1-4 counter" may be different in each timeslot.

According to the preferred embodiment of the invention, the cyclically changing bits c and d are used for the transfer of alarms so that a certain normal cd bit sequence, such as the above-described normal-state sequence 00, 01, 10, 11, is replaced with another sequence in an alarm situation. There are six (4!/4) possible sequences; in practice, this is sufficient for the transfer of all required alarms. Some alarms, such as the forward AIS alarm, can be given so that the bits c and d become fixed (e.g. 10). In other words, the number of the multiframe stops rotating intermittently. In such a case the signalling does not, of course, take place as described above; in an alarm situation, however, this is not significant.

Figures 3 and 4 show one way of realizing a codec so as to apply the method according to the invention. These embodiments correspond to the Applicant's ADPCM codec, which is a member of the product family sold under the name DYNACARD™.

In Figure 3, the input of the transmitter section 30 comprises a line interface circuit 31 where a data signal and a clock signal are separated from the incoming PCM signal PCM_{in}. The data and clock

signal are then transferred to corresponding inputs in a demultiplexer unit 32. In the demultiplexer unit, the signalling bits to be transferred in the timeslot TS16 are separated and applied to a copying unit 35. In addition, data is applied from the demultiplexer unit to a coder unit 33, and a frame synchronizing signal is applied to a coder control unit 36 which informs the coder of the coding rate (64/32/16 kbit/s) used in the system. The c and d bits of the incoming signal are eliminated in the copying unit 35. Coded data (speech) and signalling data from the copying unit (from which the original c and d bits have been removed) are connected to a cross-connect circuit 34 which rearranges the timeslots to an outbound bus TX BUS. The signalling output of the cross-connect circuit comprises a sequence changing means 38 for the bits cd in which new signalling bits c and d are added to the signalling data. The sequence changing means changes the normal sequence of the cd bits to another sequence (under the control of a processor unit 37) if an alarm has to be transferred. The sequence changing means is controlled by a cd bit sequence generator which is a counter stepping forward at intervals of one multiframe (and being reset at intervals of one superframe). The sequence generator derives the multiframe sync from the bus.

On the receiver side (Figure 4) data (speech) and signalling is obtained from a receiver bus RX-BUS to the corresponding inputs in a cross-connect block 41. The cross-connect block arranges the timeslots under the control of a processor unit 47 according to the user's selections, and applies the speech data to a decoder unit 42, the signalling bits a and b to a multiplexing unit 43, and the bits c and d to a comparison block 45. Each received speech channel is

ADPCM decoded into a normal PCM speech channel. This requires channel-associated control data which is so generic that the internal cross-connect data of the timeslot can also be disassembled on the basis of it. This also produces local c and d bits. The comparison block 45 compares the locally generated c and d bits with the received c and d bits. If they match, the comparison block applies an enable signal to the multiplexer. The enable signal updates the signalling memory in the memory of the multiplexer unit 43 for this particular channel. If the received cd bits and the locally generated cd bits do not match, the signalling of the channel is maintained unchanged until the comparison indicates that the cd bits match. The comparison block also determines whether the sequence of the cd bits is normal or whether it indicates an alarm. The processor unit 47 selects the timeslot to be monitored.

Accordingly, it is not necessary to get locked to the superframe on the receiver side but the receiver uses received signalling bits to update the signalling information of the appropriate speech channel.

After ancillary information has been transferred as described above between the transmitter and receiver sections, a conventional PCM signal PCM_{out} where the bits c and d are fixed can again be produced at the output of the receiver unit. For this purpose, the processor unit 47 assigns the multiplexer unit 43 with fixed cd bits cd_{out}. However, if some of the timeslots are not decoded in the decoder 42, the c and d bits can be connected forward.

The method according to the invention can, of course, be realized by various different device configurations. However, only some minor modifications

are required in existing devices, mainly means for providing a freely rotating two-bit multiframe counter in the transmitter section for the signalling bits.

Even though the invention has been described above with reference to the example shown in the attached drawings, it is clear that the invention is not restricted to it but it can be modified in many ways within the inventive idea disclosed above and in the accompanying claims. Even though the invention has been described above with reference to an example in which the signalling and alarms of 120 speech channels are transferred, the invention also has other applications. In place of the speech connections it is possible to transfer 16 kbit/s data channels with other associated information. The number of channels may also be e.g. 60, so that the superframe can be formed of only two multiframes. As already mentioned in the beginning, the inventive idea is not restricted to the European 2048 kbit/s basic multiplex system but the invention can also be applied to other systems of the same type.

Claims:

1. Method for transferring ancillary information, such as channel-associated signalling in a basic time-division multiplex system, where ancillary information is transferred in a predetermined timeslot (TS16) of each frame, and where information associated with more than one channel is transferred in at least one timeslot (TS1...TS15, TS17...TS31) of the basic system, characterized by assembling a superframe (12) having a length of several multiframes (11), at least part of the ancillary information being transferred in said predetermined timeslot (TS16) so that the number of the multiframe is transmitted in addition to said ancillary information, said number indicating with which channel the ancillary information is associated.

2. Method according to claim 1, characterized in that part of the ancillary information is transferred by changing the sequence of the multiframe numbers.

3. Method according to claim 1 or 2, characterized in that the assembled superframe is incoherent so that the phase of the superframe is different in different timeslots.

4. Method according to any of claims 1 to 3, characterized in that the superframe is assembled from four multiframes.

5. Method according to any of claims 1 to 3, characterized in that the superframe is assembled from two multiframes.

6. Method according to any of the preceding claims 2 to 5, characterized in that part of the ancillary information is transferred by

changing the bits (c and d) indicating the number of the multiframe (11) into fixed bits.

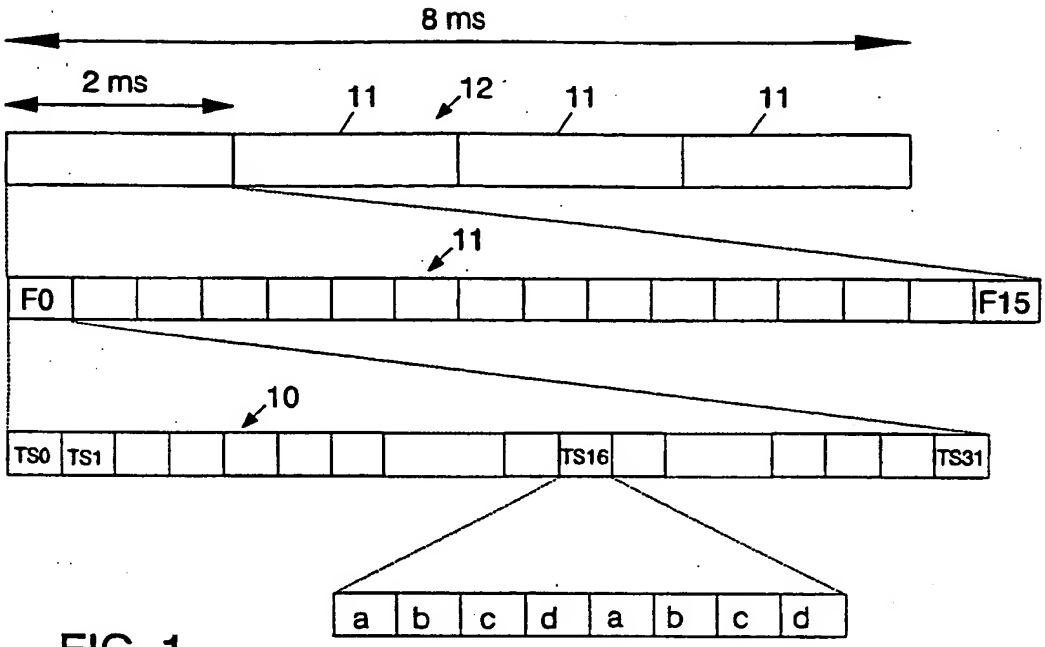
8 ms
2 ms
11
12
11
11
11
F0
F15
10
TS0
TS1
TS16
TS31
a
b
c
d
a
b
c
d

FIG. 1

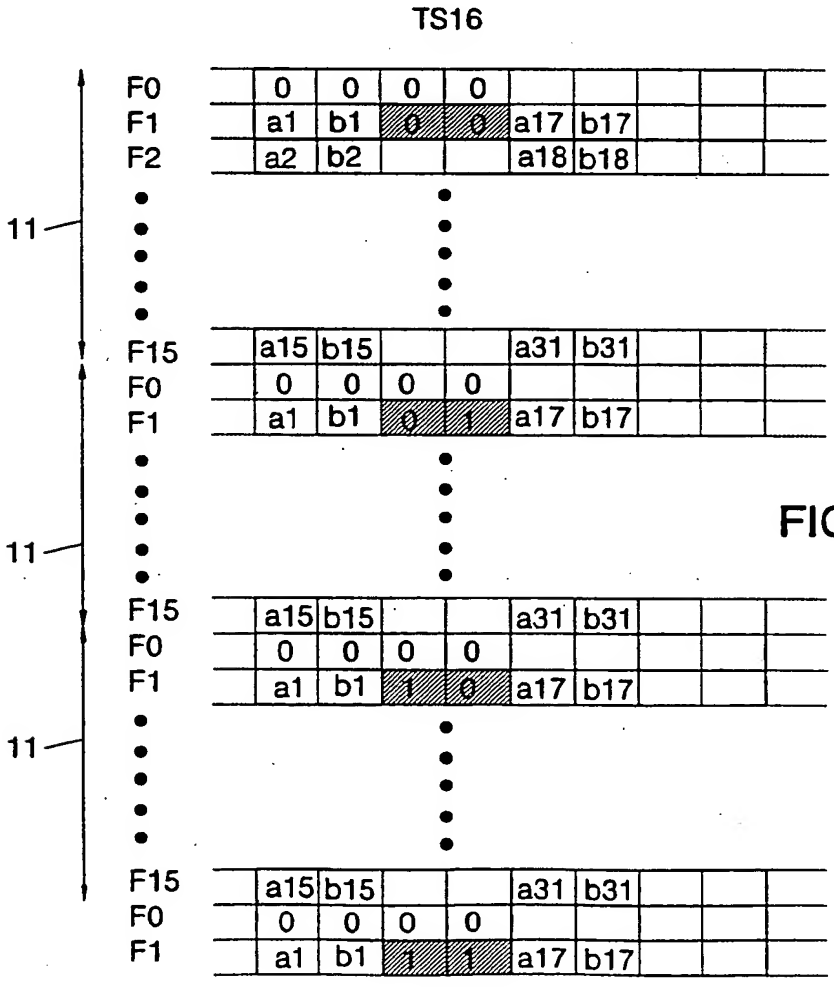
TS16
F0
F1
F2
11
F15
F0
F1
11
F15
F0
F1
11
F15
F0
F1
0 0 0 0
a1 b1 0 0 a17 b17
a2 b2 a18 b18
a15 b15 a31 b31
0 0 0 0
a1 b1 0 1 a17 b17
a15 b15 a31 b31
0 0 0 0
a1 b1 1 0 a17 b17
a15 b15 a31 b31
0 0 0 0
a1 b1 1 1 a17 b17

FIG. 2

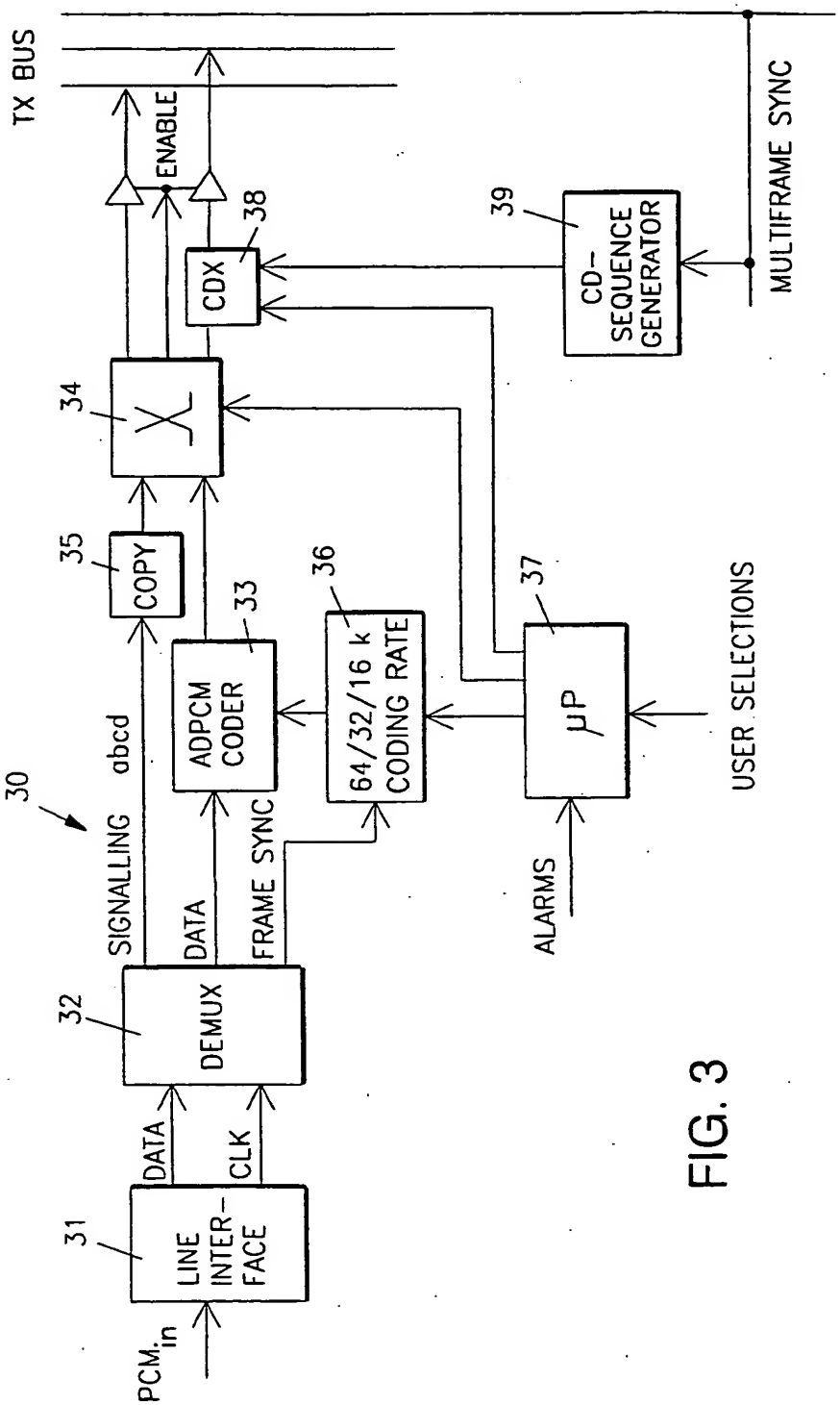
TX BUS
ENABLE
MULTIFRAME SYNC
39
CD-SEQUENCE GENERATOR
38
CDX
34
35
COPY
36
64/32/16 k CODING RATE
37
μP
USER SELECTIONS
33
ADPCM CODER
30
SIGNALLING abcd
DATA
FRAME SYNC
ALARMS
32
DEMUX
DATA
CLK
31
LINE INTER-FACE
PCM in

FIG. 3

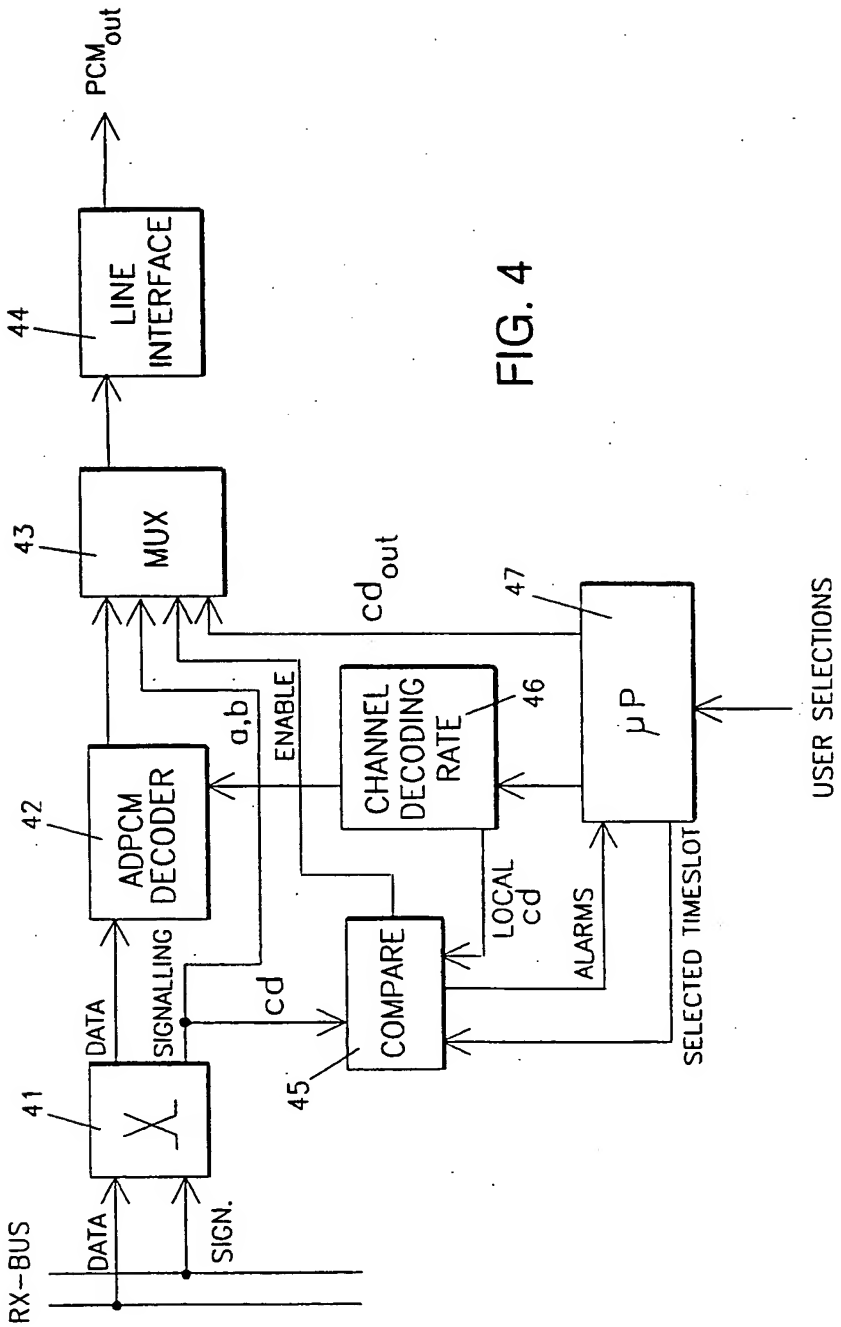
PCM out
LINE INTERFACE
44
MUX
43
cd out
47
μP
USER SELECTIONS
CHANNEL DECODING RATE
46
a,b
ENABLE
ADPCM DECODER
42
LOCAL cd
ALARMS
SELECTED TIMESLOT
DATA
SIGNALLING
cd
COMPARE
45
41
RX-BUS
DATA
SIGN.

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 93/00176

A. CLASSIFICATION OF SUBJECT MATTER

IPC5: H04J 3/12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: H04J, H04L, H04M, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

ORBIT: WPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 4358845 (GUY A.M. DE PASSOZ), 9 November 1982 (09.11.82), column 1, line 7 - column 2, line 12; column 5, line 31 - line 55, figure 5	1

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☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
12 August 1993	17 -08- 1993
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Magnus Stiebe Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

02/07/93

International application No.
PCT/FI 93/00176

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4358845	09/11/82	NONE	